

Constellation

The Return to Space Exploration



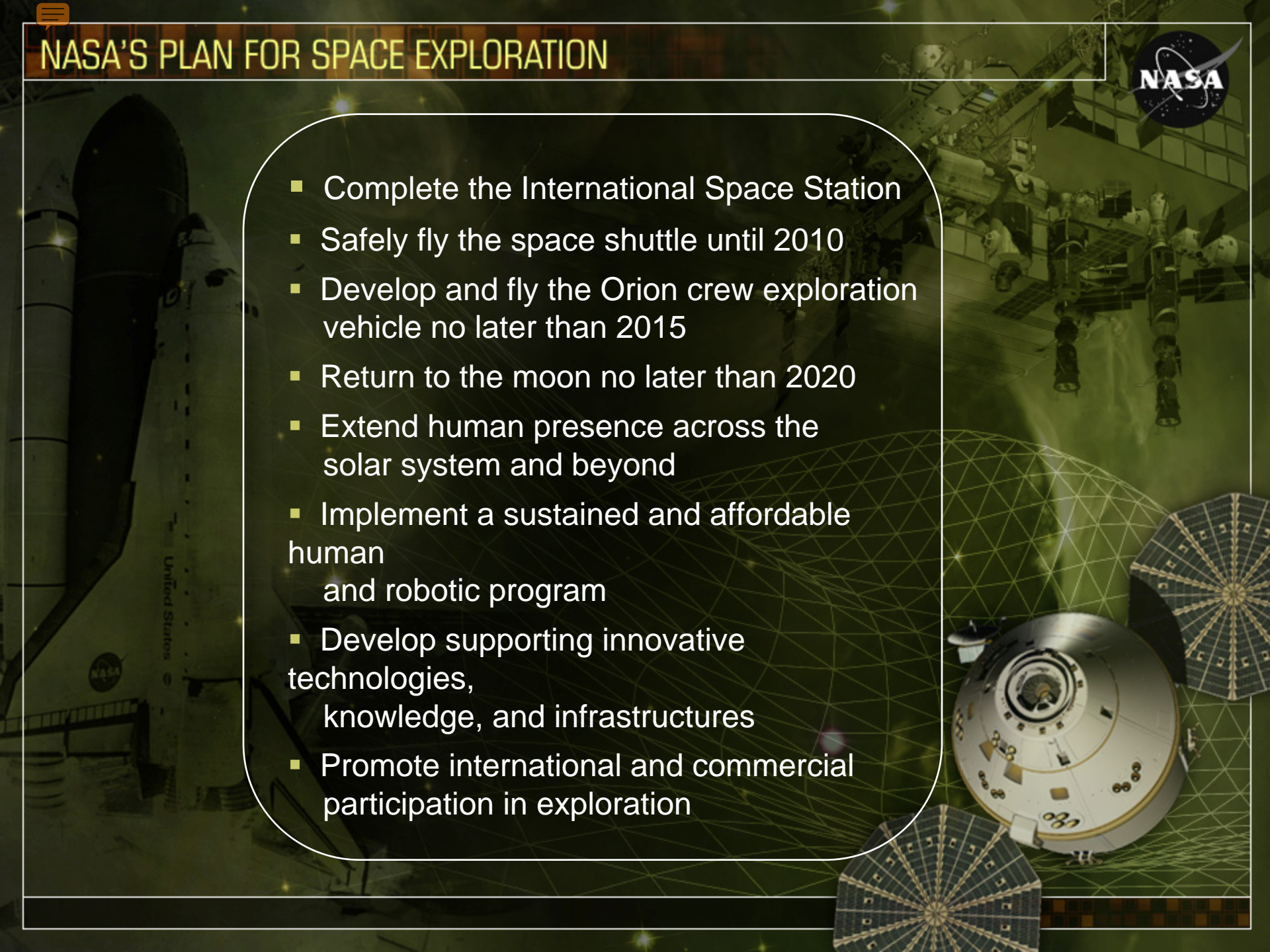
NASA Authorization Act of 2005

The Administrator shall establish a program to develop a sustained human presence on the moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations.

NASA'S PLAN FOR SPACE EXPLORATION

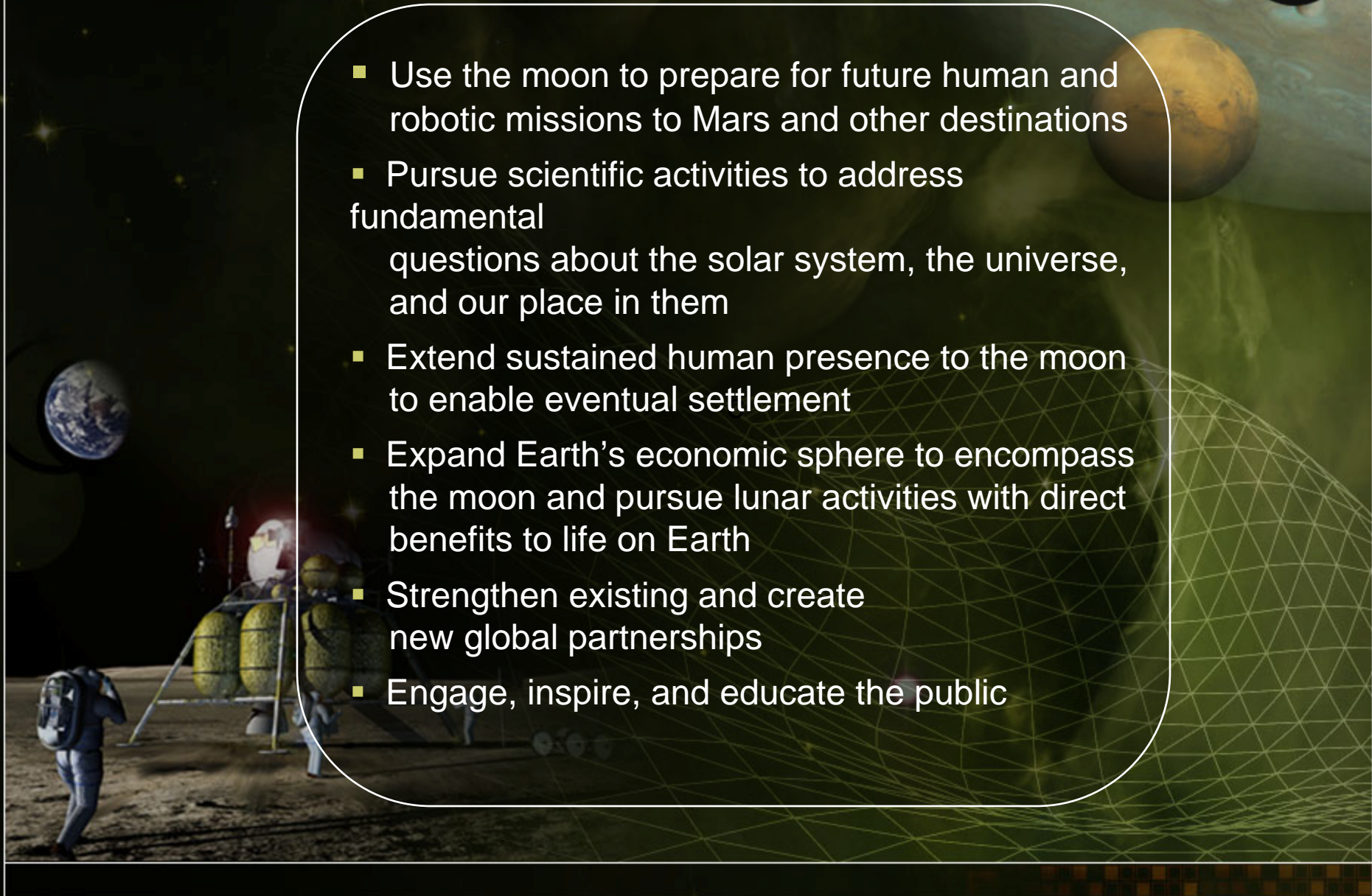


- Complete the International Space Station
- Safely fly the space shuttle until 2010
- Develop and fly the Orion crew exploration vehicle no later than 2015
- Return to the moon no later than 2020
- Extend human presence across the solar system and beyond
- Implement a sustained and affordable human and robotic program
- Develop supporting innovative technologies, knowledge, and infrastructures
- Promote international and commercial participation in exploration





- Use the moon to prepare for future human and robotic missions to Mars and other destinations
- Pursue scientific activities to address fundamental questions about the solar system, the universe, and our place in them
- Extend sustained human presence to the moon to enable eventual settlement
- Expand Earth's economic sphere to encompass the moon and pursue lunar activities with direct benefits to life on Earth
- Strengthen existing and create new global partnerships
- Engage, inspire, and educate the public



INITIAL CAPABILITY



Ares I



EVA



Orion



Mission Systems



Ground Systems

LUNAR CAPABILITY

Composite Shroud

Altair Lander

Earth Departure
Stage (EDS)

J-2X Engine

Interstage

Core Stage
(2 solid Rocket Boosters)

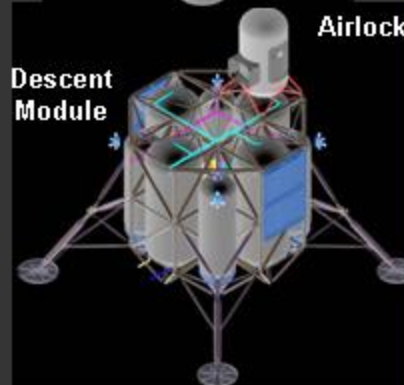


Ares V

Ascent
Module



Descent
Module



Airlock

Altair

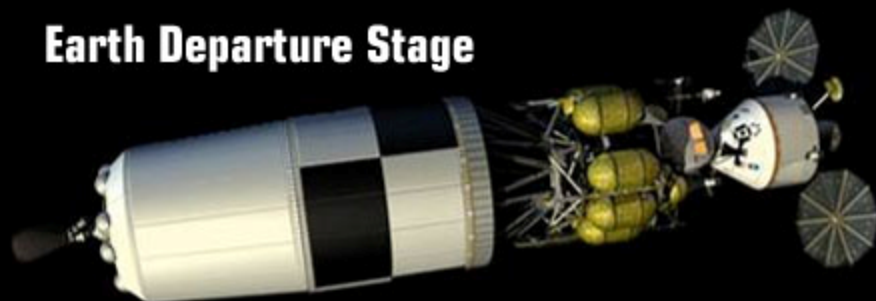


EVA

COMPONENTS OF THE CONSTELLATION PROGRAM

NASA

Earth Departure Stage



**Orion:
Crew Exploration
Vehicle**



**Ares V:
Heavy Lift
Launch Vehicle**



**Ares I:
Crew Launch Vehicle**



Lunar Lander



MAP OF CONSTELLATION CONTENT ACROSS NASA



Ames

- Lead Thermal Protection System Advanced Development Program
- Aero-Aerothermal database
- Ares Abort simulations
- Software and Guidance, Navigation & Control support

Glenn

- Lead Service Module and Spacecraft Adapter integration
- Flight Test Article "Pathfinder" fabrication
- Ares I-X upper stage simulator lead
- Ares power, thrust vector control and sensors lead
- J-2X altitude/in-space testing
- Systems Engineering & Integration support

Langley

- Lead Launch Abort System integration
- Lead landing system Advanced Development Program Ares I-X vehicle integration
- Ares aerodynamics lead
- Systems Engineering & Integration support

Goddard

- Communications Support

Marshall

- Home for Ares Project
- Ares I and V development and integration lead
- LAS and SM Systems Engineering & Integration Support

Kennedy

- Home for Ground Ops Project
- Ground processing
- Launch operations
- Recovery operations

Stennis

- Rocket Propulsion Testing for Ares

Johnson

- Home for Program
- Home for Projects: Orion, Mission Ops, EVA, Lunar Lander
- Lead Crew Module integration
- Orion Spacecraft Integration
- GFE projects management
- Flight Test Program

Dryden

- Lead Abort Flight Test Integration/Operations
- Abort Test Booster procurement
- Flight Test Article
- Development/Integration

JPL

- Thermal Protection System support

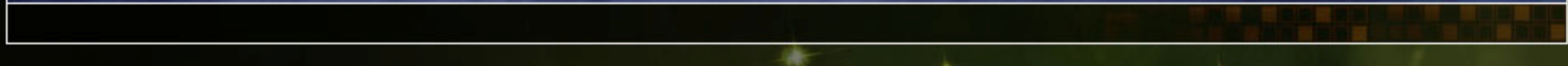
Pratt Whitney
Rocketdyne

ATK

Lockheed
Martin

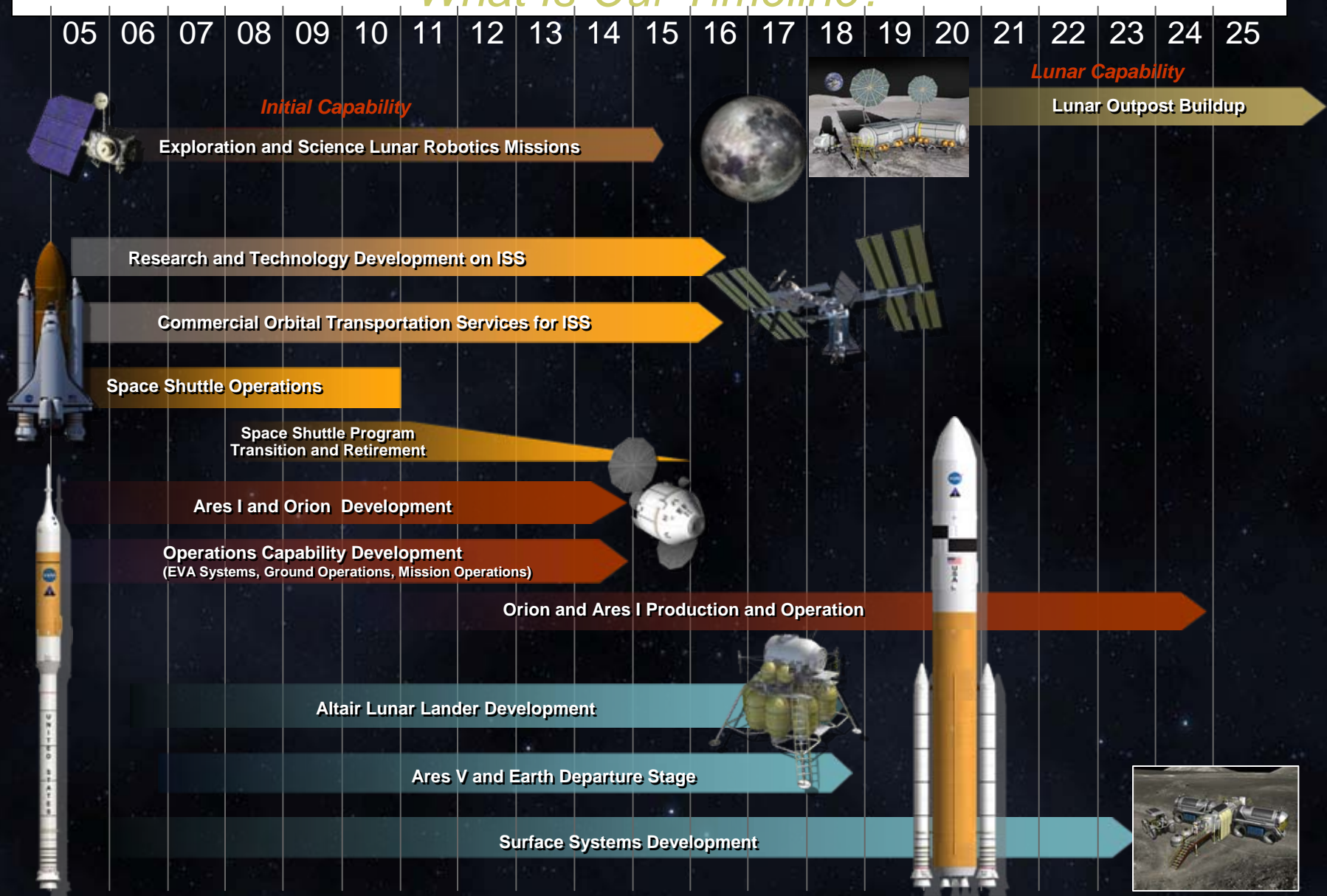
Boeing

Oceaner



NASA's Exploration Roadmap

What Is Our Timeline?



BUILDING ON A FOUNDATION OF PROVEN TECHNOLOGIES



Launch Vehicle Comparisons



HOW WE PLAN TO EXPLORE THE MOON

Project Ares: The Launch Vehicles

The safest, most reliable and most affordable means of meeting mission requirements is a system derived from proven components

- Builds on heritage from Apollo, space shuttle, commercial launch vehicles
- Capitalizes on human rated systems and existing facilities
- The most straightforward growth path to later exploration launch needs



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ARES V

ORION

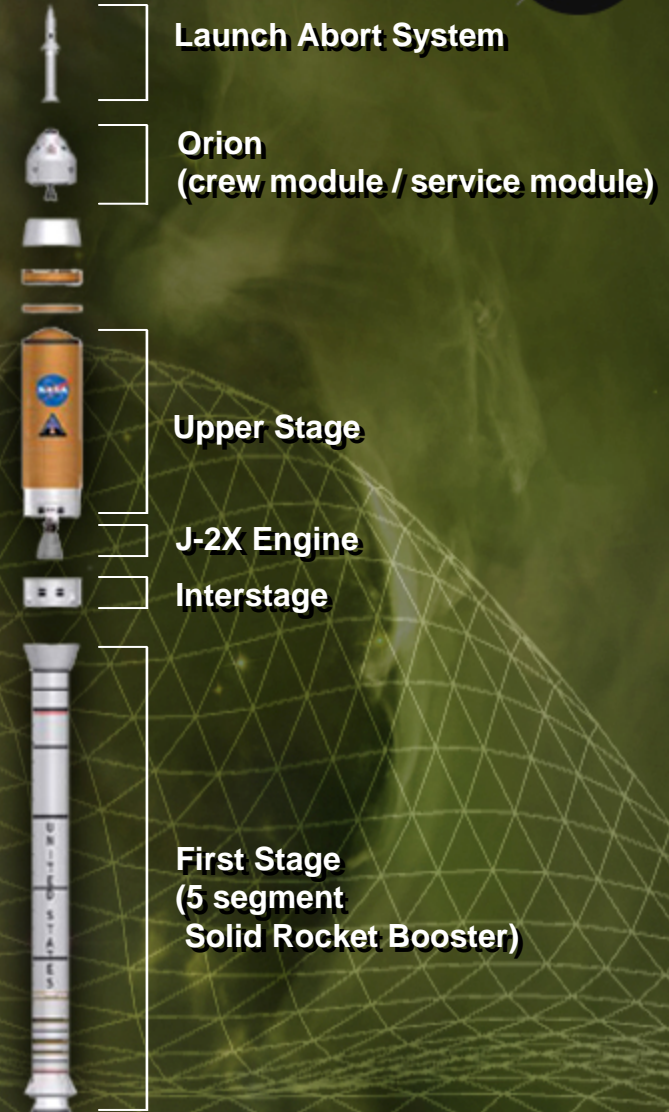
LUNAR LANDER

HOW WE PLAN TO EXPLORE THE MOON



Ares I: Crew Launch Vehicle

- Serves as the long term crew launch capability for the U.S.
- 5 segment shuttle-derived solid rocket booster
- New liquid oxygen / liquid hydrogen upper stage using J-2X engine
- Adds Launch Abort System



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HOW WE PLAN TO EXPLORE THE MOON



Ares V: Heavy Cargo Launch Vehicle

Lunar Capability

- Two 5-segment solid rocket boosters
- Liquid oxygen / liquid hydrogen core stage
 - Heritage from the Shuttle External Tank
 - Commercial heritage RS-68 main engines
- Payload capability:
 - 106 metric tons to low Earth orbit
 - 131 Metric tons to low Earth orbit using Earth Departure Stage
 - 53 metric tons trans-lunar injection capability using Earth Departure Stage
- Can be certified for crew if needed



Composite Shroud



Lunar Lander



Earth Departure Stage (EDS)



J-2X Engine



Interstage



Core Stage
(5 Segment
2 Solid Rocket Boosters)

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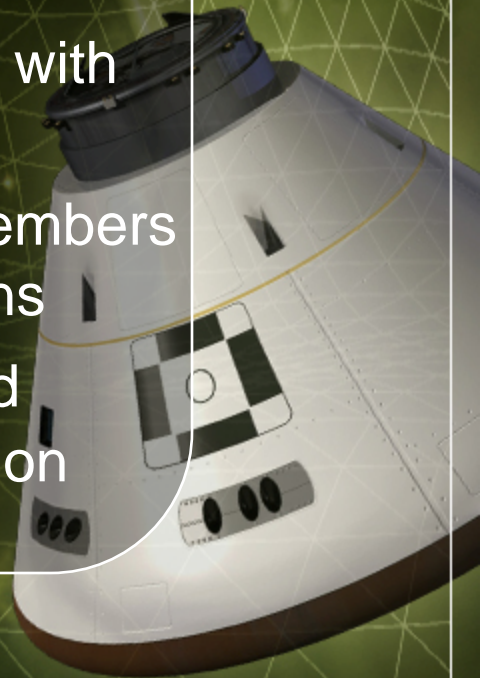
HOW WE PLAN TO EXPLORE THE MOON



Orion: The Crew Exploration Vehicle

Orion will support both moon and space station missions

- Designed to operate for up to 210 days in Earth or lunar orbit
- Separate crew and service modules
- Vehicle designed for lunar mission with 4 crewmembers
- Can accommodate up to 6 crewmembers for Mars and space station missions
- Potential to deliver pressurized and unpressurized cargo to space station



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Orion Elements

Orion Crew Exploration Vehicle (JSC)

- NASA Management and Integration
- Prime contract Lockheed Martin - Design, development and production

Spacecraft Adapter (GRC)

- Structural transition to Ares launch vehicle
- Under Prime contract

Launch Abort System (LaRC)

- Emergency escape during launch
- Under Prime Contract

Crew Module (JSC)

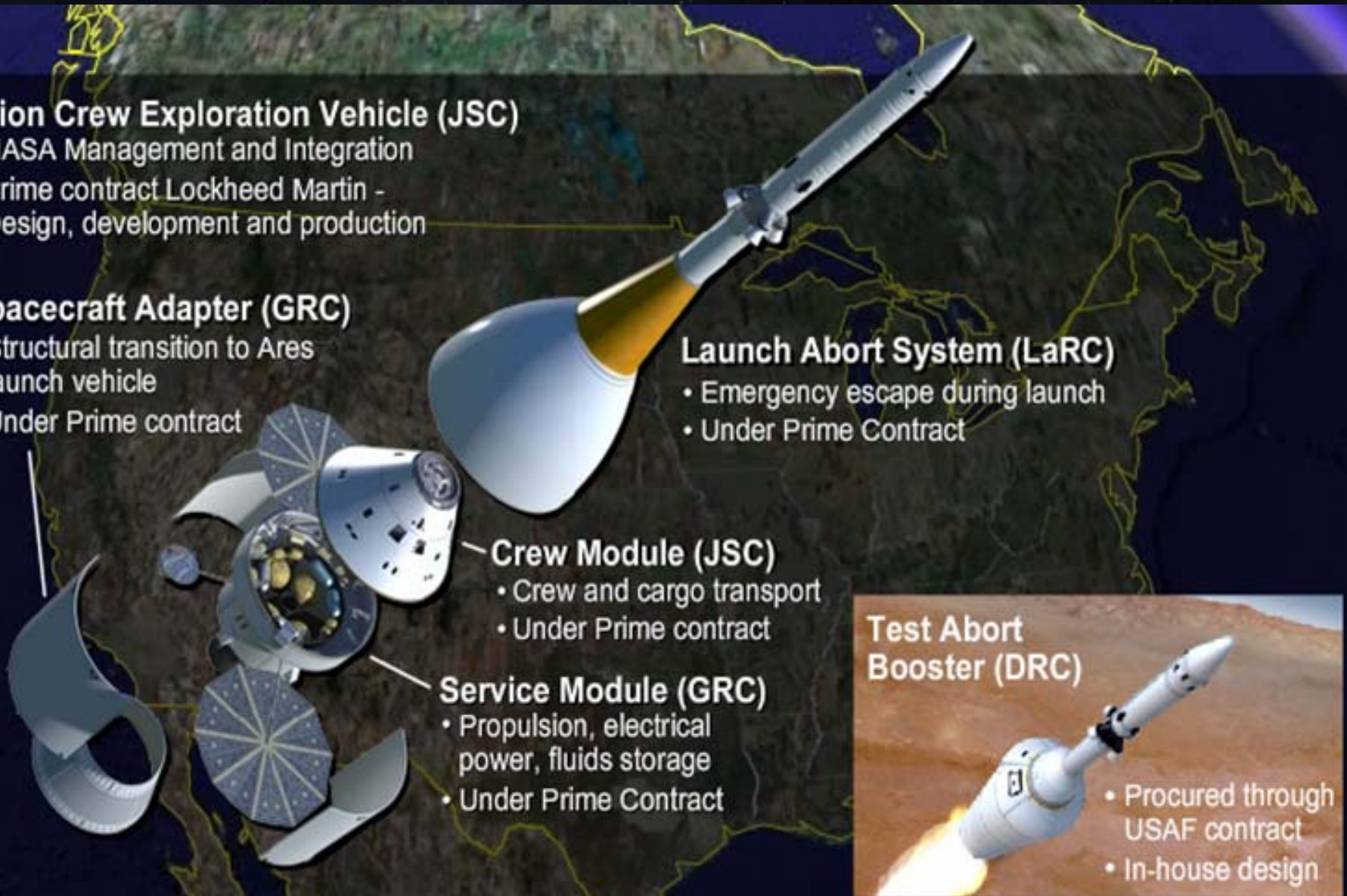
- Crew and cargo transport
- Under Prime contract

Service Module (GRC)

- Propulsion, electrical power, fluids storage
- Under Prime Contract

Test Abort Booster (DRC)

- Procured through USAF contract
- In-house design



INTERNATIONAL SPACE STATION SUPPORT



Orion: The Crew Exploration Vehicle

- Transport up to 6 crewmembers on Orion for crew rotation
- 210 day stay time
- Emergency lifeboat for entire ISS crew
- Deliver pressurized cargo for ISS re-supply

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HOW WE PLAN TO EXPLORE THE MOON



Orion: The Crew Exploration Vehicle

Orion faces same re-entry speeds, temperatures, structural stress as Apollo

- Using proven shape saves development time
- Shape minimizes re-entry loads and provides landing stability
- Orion capsule has twice the volume of Apollo

APOLLO 10
COMMAND MODULE

11 FT.
5 IN.

12 FT.
10 IN.

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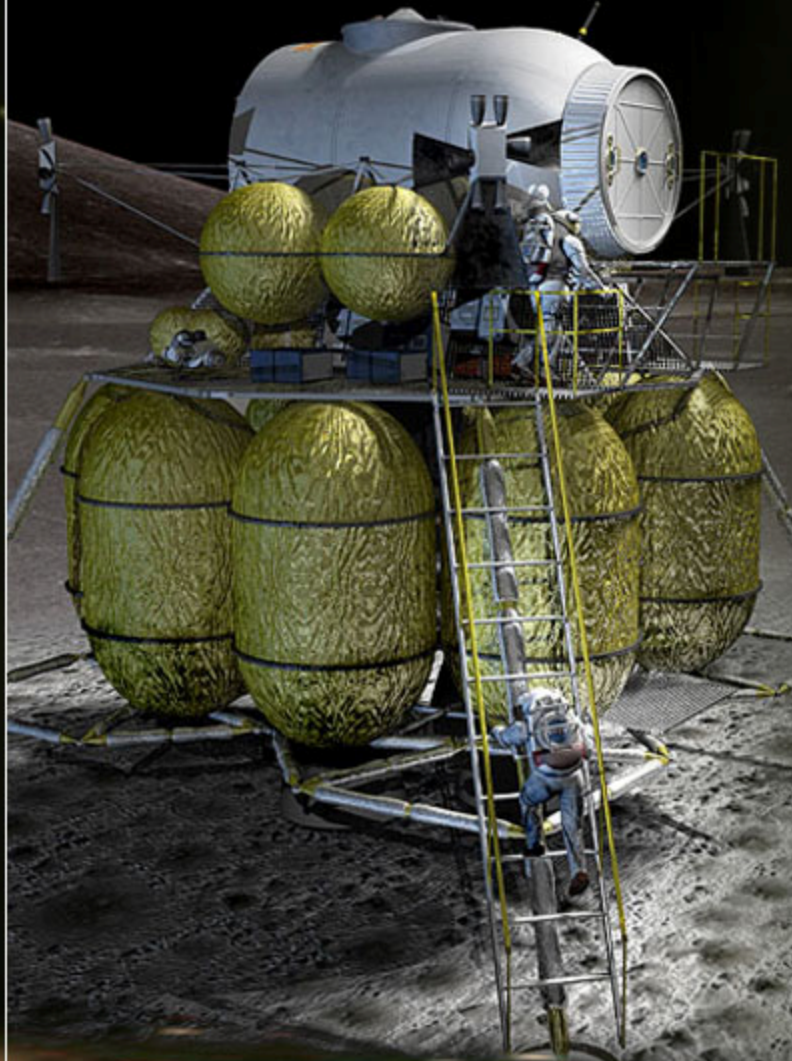
ARES V

ORION

LUNAR LANDER

THE LUNAR LANDER

NASA's Goals for Lunar Lander



- Transport 4 crewmembers to and from the surface
 - Visits start with 7 days on surface
 - Length of stays increases step-by-step
 - Builds up to 6 month lunar outpost crew rotations
- Global access capability
- Return to Earth anytime
- Deliver about 16 metric tons of dedicated cargo
- Provide airlock for surface activities
- Descent stage:
 - Liquid oxygen / liquid hydrogen propulsion
- Ascent stage:
 - Storable propellants

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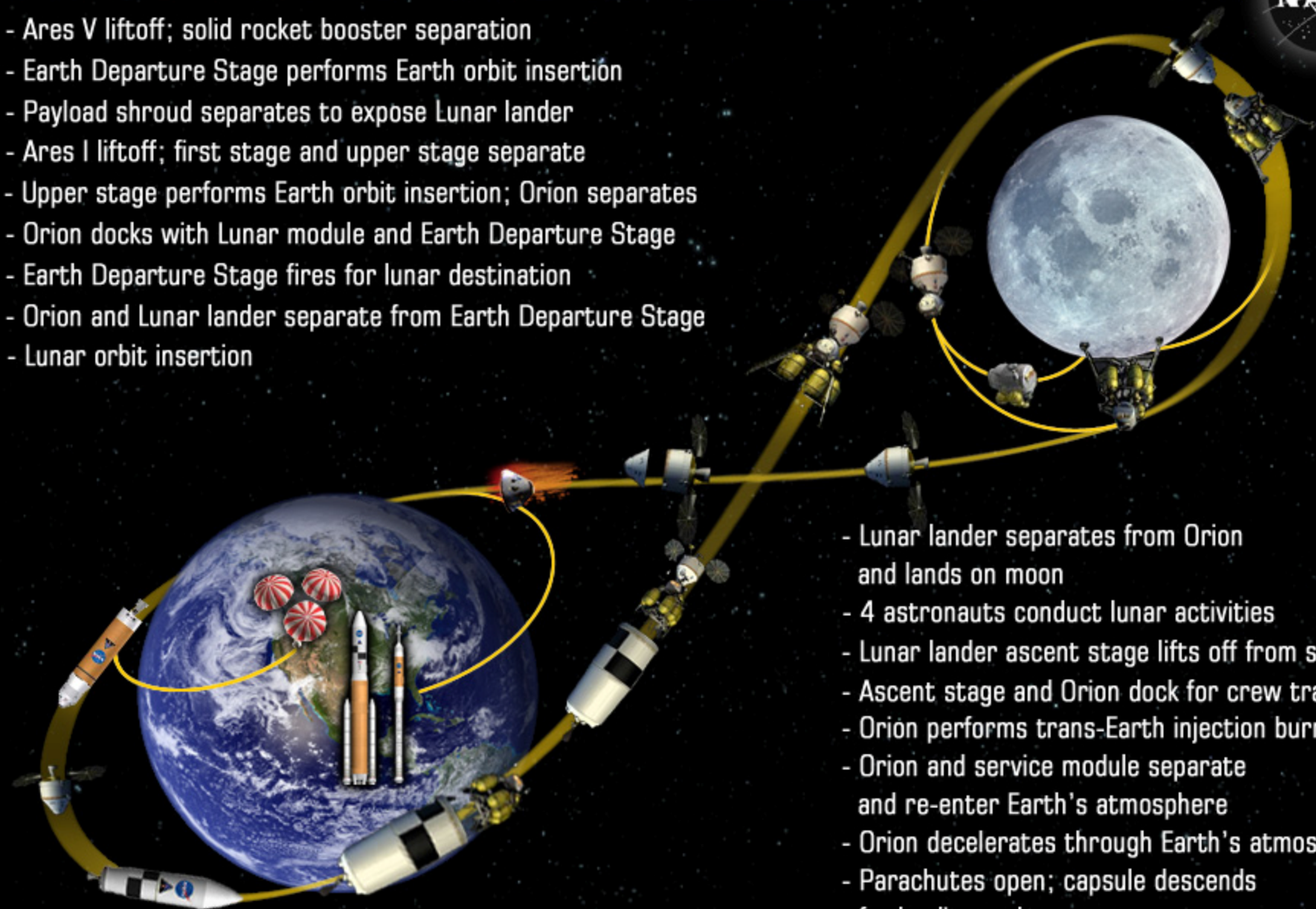
LUNAR LANDER

TYPICAL LUNAR REFERENCE MISSION

NASA

- Ares V liftoff; solid rocket booster separation
- Earth Departure Stage performs Earth orbit insertion
- Payload shroud separates to expose Lunar lander
- Ares I liftoff; first stage and upper stage separate
- Upper stage performs Earth orbit insertion; Orion separates
- Orion docks with Lunar module and Earth Departure Stage
- Earth Departure Stage fires for lunar destination
- Orion and Lunar lander separate from Earth Departure Stage
- Lunar orbit insertion

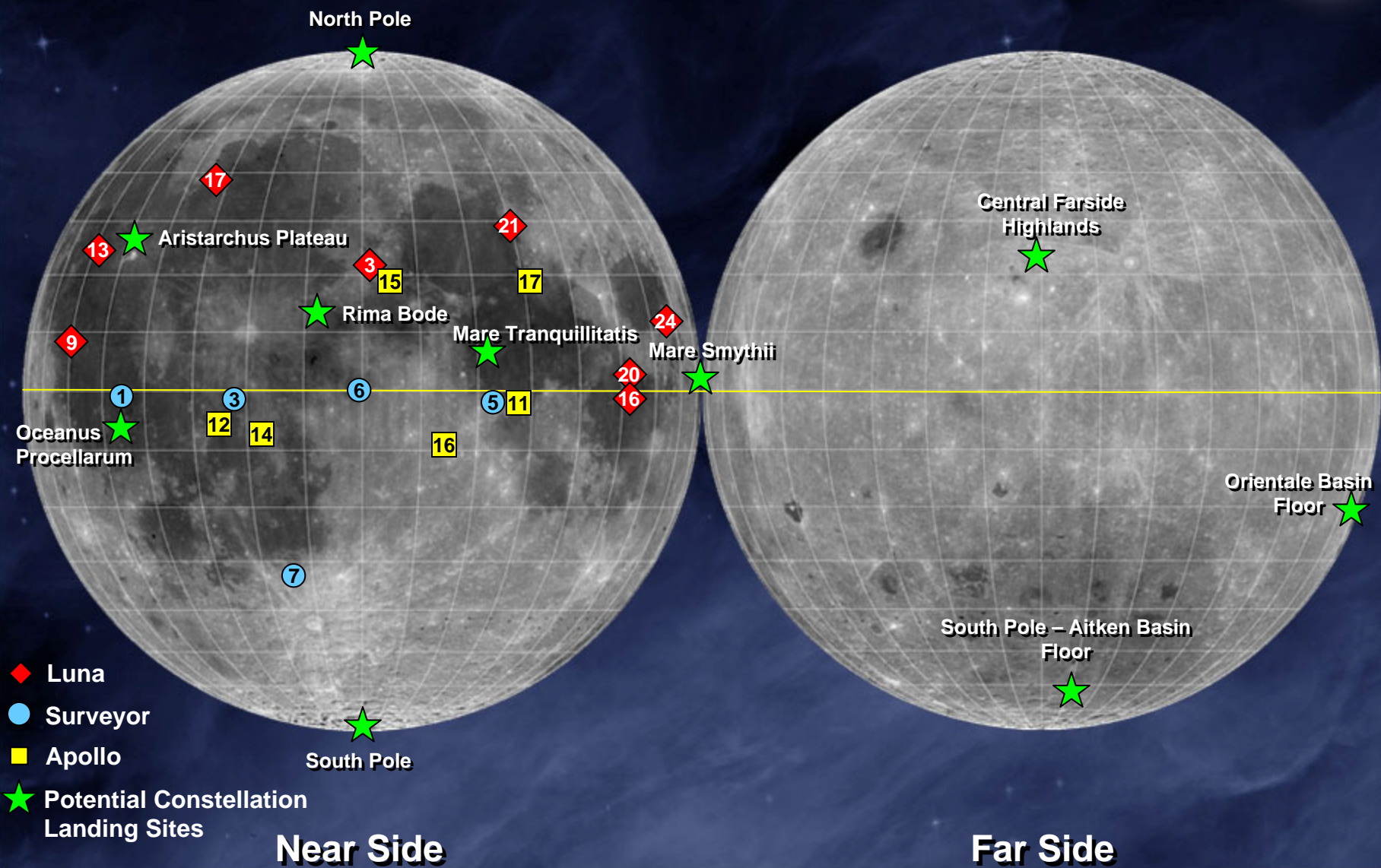
- Lunar lander separates from Orion and lands on moon
- 4 astronauts conduct lunar activities
- Lunar lander ascent stage lifts off from surface
- Ascent stage and Orion dock for crew transfer
- Orion performs trans-Earth injection burn
- Orion and service module separate and re-enter Earth's atmosphere
- Orion decelerates through Earth's atmosphere
- Parachutes open; capsule descends for landing and recovery



CONSTELLATION CAN LAND ANYWHERE ON THE MOON



Previous Missions Landed in Equatorial Band





Lunar Mission

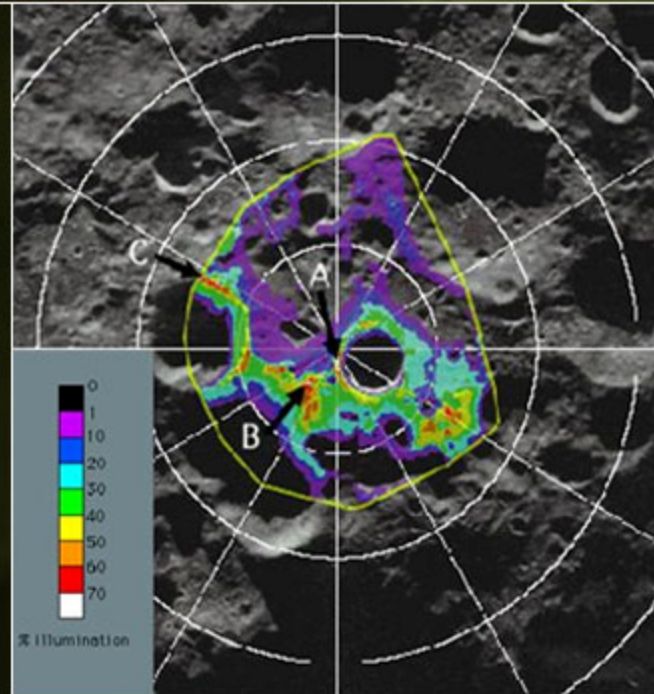
Click link below:

- 1) Click on middle of map to load site**
- 2) Go to Missions tab and Select Lunar**
- 3) Click Play button and turn up volume:**

<http://www.explorationworkforce.com/draftmap>

POSSIBLE SOUTH POLE OUTPOST

- The lunar South Pole is a likely candidate for an outpost site
- Several areas with greater than 80% sunlight and less extreme temperature swings
- Elevated quantities of hydrogen, possibly water ice in permanently shadowed craters
- Step-by-step outpost construction:
 - Power system
 - Communications/navigation
 - Habitat
 - Rovers



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LUNAR LANDER

THE FIRST STEP TO MARS AND BEYOND



- Regaining and extending operational experience in a hostile planetary environment
- Developing capabilities needed for opening the space frontier
- Preparing for human exploration of Mars
- Science operations and discovery

Using Current Shuttle Workforce and Infrastructure

- **Ares I-X Test Flight 2009**

- Comprised of re-outfitted SRB serving as the first stage
- Launching from the Shuttle Mobile Launch Platform
- Relies on current KSC/USA Ground Processing workforce and facilities





“Put foot prints next to tire prints on Mars”

